

REMARKS

In view of the above amendments and following remarks, reconsideration of the rejections contained in the Office Action of September 3, 2003 is respectfully requested.

In the Office Action, the Examiner rejected claims 2-6, 8-12 and 17-28 as being indefinite. Claim 17 was considered to lack antecedent basis for a limitation contained therein, and all of claims 2-6, 8-21 and 23-28 were not considered to further limit the claims from which they depend or recited process limitations in apparatus claims. The Examiner did not consider the solution in the baths and substrate to be part of the apparatus structure. The Examiner's positions are respectfully traversed.

It is first noted that claims 1-12 have been canceled. Claim 13 has been redrafted into independent form. It is not believed that the rejections based upon indefiniteness apply to this claim in view of the clear recitation of structural elements and proper antecedent basis. Accordingly, it is respectfully submitted and believed that claims 13-15 are definite.

Claims 17-28, furthermore, have been canceled. Thus, it is believed that the rejections raised by the Examiner have been rendered moot. Nonetheless, Applicants reserve their rights to traverse the position taken by the Examiner should such be necessary at any later point in time. That is to say, Applicants do not acquiesce in the position taken by the Examiner.

Claims 1, 4 and 7 were rejected as being anticipated by McCary et al. However, as noted above, these claims have been canceled.

Claims 16 and 29-31 were indicated as being allowed. The Examiner's indication of allowable subject matter is gratefully acknowledged. Thus, nothing further regarding these claims should be necessary at this time.

The Examiner further indicated that claim 13 would be allowable if rewritten in independent form so as to include the limitations of its base claim. Claim 13 has now been so-rewritten. Accordingly, claim 13, and claims 14 and 15 depending therefrom, should also now clearly be in condition for allowance. Indication of such is respectfully requested.

In addition, the above amendments present new claims 32-36. Of these claims, claims 32 and 35 are independent claims which clearly distinguish over McCary et al.

According to the invention of independent claim 32, an apparatus for plating a metal within fine pits and a surface of a substrate has a first plating bath for containing a first plating solution to form a first plating layer of the metal by electroplating with a first current density within the fine pits formed in the surface of the substrate. A second plating bath contains a second plating solution different from the first plating solution to form a second plating layer of the metal by electroplating with a second current density on the first plating layer. The second current density is larger than the first current density. Referring to the specification, an example can be found on page 16 in which it is recited that a first current density is 0.5 A/dm² and second current density is 2 A/dm².

Thus, according to the present invention, a uniform initial plating layer, without unplated areas on the side walls and bottom of the fine pits, is formed. In the second plating process, a surface plating layer is formed on top of the initial plating layer. As a result, fine pits formed on the substrate, such as fine channels for wiring, can be filled with copper, copper alloy or other material having a low electrical resistance, without gaps in the metal plating and with a level surface.

McCary et al. discloses an apparatus for plating including a plurality of baths 16, 18, 22, 26 and 32. In copper bath 18, a thick copper layer 20 is rapidly deposited upon a gold strike layer at a high current density (for example 100 mA/cm²). In copper bath 22 a current density of 30/40 mA/cm² is employed to deposit a 1/5 mm thick smooth copper layer 24 upon copper layer 20. Note column 3, lines 17-54, and Figs. 1 and 2 of McCary et al. However, McCary et al. fails to disclose a first bath to form a first plating layer of a metal by electroplating with a first current density and a second bath to form a second plating layer of the metal by electroplating with a second current density, where the second current density is larger than the first current density. Thus the present invention as reflected by claim 32 is neither disclosed nor suggested from McCary et al.

The invention according to independent claim 35 is an apparatus for plating a plurality of fine pits covered with a barrier layer in a surface of the substrate having a first plating bath for containing a first plating solution to form a first plating layer directly on the entire surface of the barrier layer within the fine pits, and a second plating bath for containing a second plating solution to form a second plating layer on the first plating layer. Thus according to this invention, a uniform initial plating layer without unplated areas on the side walls and bottom of the fine pits covered by the

barrier layer, such as TaN or TiN, is formed in the first plating process. A surface plating layer is formed on top of the initial plating layer in the second plating process.

McCary et al. fails to disclose or suggest forming a first plating layer directly on the entire surface of a barrier layer within fine pits. Thus, the present invention as reflected by independent claim 35 is neither disclosed nor suggested by McCary et al.

In view of the above, all of new claims 32-36 are submitted to be in condition for allowance. Thus all of the claims now pending in the present application are now in condition for allowance. Indication of such is respectfully requested.

In view of the above amendments and remarks, it is submitted that the present application as a whole is now in condition for allowance, and the Examiner is requested to pass the case to issue. If the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact Applicants' undersigned representative.

Respectfully submitted,

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